

EPA		United States Environmental Protection Agency Washington, DC 20460 Work Assignment		Work Assignment Number <div style="text-align: right; font-size: 1.2em;">0-41</div>						
Contract Number <div style="text-align: right;">EP-C-09-027</div>		Contract Period <div style="text-align: right;">April 1, 2009 - March 31, 2010</div>		Title of Work Assignment/SF Site Name <div style="text-align: right;">See below comments</div>						
Contractor <div style="text-align: right;">ARCADIS</div>		Specify Section and Paragraph of Contract SOW								
Purpose: <div style="display: flex; justify-content: space-between; margin-top: 5px;"> <div> <input checked="" type="checkbox"/> Work Assignment <input type="checkbox"/> Work Assignment Amendment <input type="checkbox"/> Work Plan Approval </div> <div> <input type="checkbox"/> Work Assignment Close-Out <input type="checkbox"/> Incremental Funding </div> </div>		Period of Performance <div style="text-align: right;">From 5/18/09 To 3/31/10</div>								
Comments: Behavior of Cs in Incinerators Processing RDD Biomass Waste										
<div style="display: flex; justify-content: space-between;"> <input type="checkbox"/> Superfund Accounting and Appropriations Data <input type="checkbox"/> Non-Superfund </div>										
Note: To report additional accounting and appropriations data use EPA Form 1900-89A.										
SFO (Max 2) 22										
S	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)	(Cents)	Site/Project (Max 8)	Cost Org/Code (Max 7)
1										
2										
3										
4										
5										
Authorized Work Assignment Ceiling										
Contract Period:		Cost/Fee:		LOE:		0				
This Action:						1699				
Total:						1699				
Work Plan / Cost Estimate Approvals										
Contractor W/P Dated:		Cost/Fee:		LOE:						
Cumulative Approved:		Cost/Fee:		LOE:						
Work Assignment Manager Name <div style="display: flex; justify-content: space-between; align-items: flex-end;"> <div style="text-align: center;"> (Signature) </div> <div style="text-align: center;"> <div style="font-size: 1.2em;">5/6/09</div> (Date) </div> </div>						Branch/Mail Code: Phone Number: FAX Number:				
Project Officer Name <div style="display: flex; justify-content: space-between; align-items: flex-end;"> <div style="text-align: center;"> (Signature) </div> <div style="text-align: center;"> <div style="font-size: 1.2em;">5/13/09</div> (Date) </div> </div>						Branch/Mail Code: Phone Number: 919-541-2708 FAX Number: 919-541-1536				
Other Agency Official Name <div style="display: flex; justify-content: space-between; align-items: flex-end;"> <div style="text-align: center;"> (Signature) </div> <div style="text-align: center;"> <div style="font-size: 1.2em;">5/7/09</div> (Date) </div> </div>						Branch/Mail Code: Phone Number: FAX Number:				
Contracting Official Name <div style="display: flex; justify-content: space-between; align-items: flex-end;"> <div style="text-align: center;"> (Signature) </div> <div style="text-align: center;"> <div style="font-size: 1.2em;">5/18/09</div> (Date) </div> </div>						Branch/Mail Code: C.POD Phone Number: 513-487-2094 FAX Number: 513-487-2109				

Scope of Work

Behavior of Cs in Incinerators Processing RDD Biomass Waste

PURPOSE OF WORK ASSIGNMENT

The contractor shall provide support for operation, maintenance, sampling/analysis, and modification to the in-house rotary kiln incinerator simulator (RKIS) and associated systems, as well as the bench-scale gasifier. This work assignment is applicable to Contract Sections 1.2, 2.0, 3.0, 4.0, 5.0, 7.0, and 8.0.

Background

In the aftermath of a Radiological Dispersal Device (RDD) in an urban setting, there is the potential for the generation of significant quantities of contaminated biomass. These wastes are likely candidates for incineration as a means for volume reduction, due to the costs of disposal for Low Level Radioactive Waste (LLRW). Cesium (Cs), a metallic element, is a likely radionuclide that may be found in an RDD, and presents problematic behavior in combustion systems due to its volatility and solubility in water. Many wastes and fossil fuels contain toxic trace metal constituents. Unlike organic compounds, combustion or incineration systems cannot destroy the elemental metal constituents, although high temperature combustion environments will induce metal transformations. These transformations are usually thought to exacerbate their harmful effects, since many of the metal species, including Cs, readily vaporize within combustion environments. Subsequently, this saturated vapor will nucleate and condense downstream of the flame, contributing to a fume of submicron aerosol. These particles, because of their small size, are difficult to collect in pollution control systems. Emissions of particulate-bound radioactive isotopes, such as ^{137}Cs , from combustion systems, are highly undesirable. Moreover, chlorinated metal species that are collected often exhibit increased volatility, while chlorinated and sulfated metal species may exhibit increased water leachability.

The purpose of this research is to investigate biomass-bound Cs behavior, speciation, and transformations in combustion and incineration systems and examine methods and modifications to control Cs speciation and particle size distribution. One process of interest involves sorbent injection, whereby the high temperatures of practical incinerators might be exploited to transform Cs into constituents that are both more easily collected than Cs-containing effluents in the absence of combustion modifications.

Past work (Yoo et al., 2005) has shown that magnesium-based sorbents can capture significant quantities of Cs fed into a combustion system in atomized liquid form. This approach has not been tested on Cs bound on biomass type materials. Experiments examining metal transformations and in-situ capture of toxic metals by sorbents use a small laboratory scale 82 kW in-house research combustor (rainbow furnace). Cs will be introduced into the vertical furnace bound on sawdust, through a variable swirl burner. Kaolinite, bauxite, and hydrated lime are typically injected along the centerline in the postflame, near the peak system temperature. Measurements of both the submicron aerosol size distribution and the size segregated particulate composition in the exhaust allowed the effects of sorbent injection to be ascertained, both with and without the presence of chlorine, sulfur or other constituents.

Objectives

The objective of this research is to examine biomass-bound Cs behavior and transformations and determine if combustion modifications including sorbent injection into the post combustion zone of practical incinerators and combustors could be used to convert Cs, into easily collected forms. Pertinent mechanisms are inferred by: (1) examining metal aerosol behavior (particle size distribution and chemistry) as a function of fuel/waste composition and operating parameters (2) by determining how sorbent injection modifies the submicron size distribution of the metal containing aerosol in the exhaust, and (3) by interpreting detailed morphological and chemical analyses of size segregated particulate matter extracted from the exhaust. This work will all be done using ^{133}Cs , the stable isotope of Cs which from a chemistry standpoint behaves identically to the radioactive isotopes.

Scope of Work

The SOW shall include the following subtasks:

1. Examine particle formation from Cs precursors including the influences of other combustion species (Cl, S) on Cs speciation and aerosol formation and growth.
2. Examine the role of sulfur on Cs-sulfate formation and how this affects the resultant metal solubility.
3. Examine the similarities/differences of initial metal form (e.g., aqueous solution vs. organometallic) on the resulting aerosol behavior.
4. Examine the nature of the reaction products obtained from interaction between trace metals and the candidate sorbent substrates (including kaolinite, bauxite, and limestone).
5. Examine Cs vaporization and subsequent nucleation/condensation as a function of axial position, time, temperature, and variations in the concentrations of chlorine and sulfur.
6. Optimize sorbent injection for practical situations; and extend experimental scope to lower metal (5 ppm) concentrations. Sorbent parameters include injection temperature, stoichiometry, and residence time.

Furnace Operation

The contractor shall provide technical support, operating experience, analytical support, and expendable materials to conduct these tests using the EPA rainbow furnace. This support shall include:

1. Provide expendable materials and building supplies to modify, operate, and maintain the rainbow furnace, or other in-house combustor, as appropriate.
2. Provide engineering and operating labor for the design and execution of test plans on these furnaces.
3. Maintain, calibrate, and operate monitoring equipment according to NRMRL/APPCD's Recommended Operating Procedures (ROPs) and instrument manuals.
4. Collect and retain necessary operational data to ensure compliance EPA Safety, Health, and Environmental Management (SHEM) requirements.

Documentation of Technical Direction

The WAM and contractor's project manager shall schedule periodic project meeting in which task progress, issues, and future direction will be discussed. The contractor's project manager shall summarize the notes from each of these meetings in the form of an e-mail message to the WAM. This summary shall help assure clear communication, establish project priorities, and provide documentation of technical direction.

Reports of Work

The following reports of work shall be provided to the WAM.

1. Monthly progress reports with labor costs and ODC charges.
2. Health and safety plans as required by EPA SHEM group.

3. QA/QC plans as required by EPA QA officer. The awardee shall comply with all requirements as delineated on the "Quality Assurance Planning Requirements Form" included with this extramural action.
4. Update Rainbow Combustor Facility Manual as required by EPA QA officer.
5. Operate Compliance reports as required by SHEM data needs.

References

Yoo, J., Shinagawa, T., Wood, J., Linak, W., Santoian, D., King, C., Seo, Y., and J. Wendt, "High-Temperature Sorption of Cesium and Strontium on Dispersed Kaolinite Powders" Environ. Sci. Technol. 2005, 39, 5087-5094.

NHSRC QUALITY ASSURANCE REQUIREMENTS FORM
Attachment 1 to the Statement of Work

I GENERAL INFORMATION

Title: Behavior or Cs in Incinerators Processing RDD Biomass Waste
Description: RDD
Project ID: DCMD 4.31
Status: Original
Number Ammended:
QA Category: IV
Action Type: Extramural
Peer Review Category:
Security Classification: FOUO
Project Type: Basic Research
QAPP Status 1: Not Delivered
Vehicle Status: New Vehicle
Vehicle Type: Contract

If you are processing an IAG or CRADA, the responsibility for QA must be negotiated within the agreement. The TLPs in consultation with the QAMs in the various organizations must agree on, and document, which organization will take the lead for QA, the names of the QAM and TLP from each organization, and the QA requirements that will be adhered to during the agreement. Include this info in the IAG/CRADA package.

II SCOPE OF WORK

Yes Does the Statement of Work contain the appropriate QA language?

The awardee shall comply with all requirements as delineated on the "Quality Assurance Planning Requirements Form (QARF)" included with this extramural action. The contractor shall prepare a QAPP in accordance with the R-2 and R-5 and/or the attachments provided with the SOW. The QAPP must be approved prior to the start of any work. Additional information related to QA requirements can be found at <http://www.epa.gov/quality/qs-docs/r5-final.pdf>

Yes Does this extramural action involve the collection, generation, use, and/or reporting of environmental data; the design, construction, and operation of environmental technologies; or development of software, models, or methods?

(If "No" then skip to Section IV, and sign the form.)

Yes Will the SOW or any subsequent work assignments or task orders involve any cross-organizational efforts within EPA?

Which organization will take the lead for QA?
NHSRC

No Has a QAPP already been approved for the activities specified in the SOW?

Yes Is an applicable QAPP in the process of being prepared, revised, or approved by EPA personnel for future use by the contractor? (QA approval must be obtained before the contractor can start work.)

Provide the expected title for submission to QA staff for approval:

An additional QAPP for CW simulants will be submitted
Provide the approximate date for submission to QA staff for approval:
05/29/2009

III QA DOCUMENTATION OPTIONS

All documentation specified under "Other" must be defined in the NHSRC Quality Management Plan and be consistent with requirements defined in EPA Manual 5360 A1. For all items checked below, there must be adequate information in the SOW (or its appendices) for the offeror to develop this documentation. Where applicable, reference a specific section of the SOW. (R-2 refers to EPA Requirements for Quality Management Plans (QA/R-2) (EPA/240/B-01/002, 03/20/01) and R-5 refers to EPA Requirements for Quality Assurance Project Plans (QA/R-5) (EPA/240/B-01/003, 03/20/01). Copies of these documents are available at http://www.epa.gov/quality/qa_docs.html.)

Before Award Documentation

Not Applicable	Documentation of an organization's Quality System. QMP developed in accordance with:
Not Applicable	Combined documentation of an organization's Quality System and application of QA and QC to the single project covered by contract. Developed in accordance with: Programmatic QA Project Plan developed in accordance with:
Not Applicable	Application of QA and QC activities to the single project covered by contract. QA Project Plan developed in accordance with:

After Award Documentation

R2	Documentation of an organization's Quality System. QMP developed in accordance with:
Not Applicable	Combined documentation of an organization's Quality System and application of QA and QC to the single project covered by the contract. Developed in accordance with:
Other	Documentation of the application of QA and QC activities to applicable project(s). Developed in accordance with: Explain: The QAPP should be developed in accordance with the QAPP requirements for basic research
n/a	Programmatic QA Project Plan with supplements for each specific project, developed in accordance with:
Not Applicable	Existing documentation of the application of QA and QC activities will be used:

IV SIGNATURE BLOCK

The signatures below verify that the Statement of Work (SOW) has been reviewed to ascertain the necessary QA and QC activities required to comply with EPA Order 5360.1 A2, that the COR understands these requirements, and that the COR will ensure that the quality requirements indicated on the previous pages of this form are incorporated into all associated SOWs. (Sign/date below, obtain a concurrence signature from the QA Staff, and submit the form along with the other extramural action documentation.)

Signature on file _____ Ramona Sheridan 5/18/09

QAPP REQUIREMENTS FOR BASIC RESEARCH PROJECTS (from Appendix B of the NHSRC QMP)

A basic research project is a study performed to generate data used to evaluate unproven theories, processes, or technologies.

SECTION 1.0, PROJECT OBJECTIVES AND ORGANIZATION

1.1 State the project objectives.

1.2 Identify the responsibilities of all project participants (e.g. QAPP preparation, sample collection and analyses, data reduction/validation/analysis, report preparation, QA).

SECTION 2.0, EXPERIMENTAL APPROACH

2.1 Describe the process, site, facility, apparatus, and/or environmental system to be tested.

2.2 Describe all known or pre-established test conditions and variables, including replicate experimental runs.

2.3 Describe the planned approach (statistical and/or non-statistical) for evaluating project objectives (i.e., data analysis).

SECTION 3.0, SAMPLING AND MEASUREMENT APPROACH AND PROCEDURES

3.1 Complete the following table to summarize the sampling strategy to be used.

Sample/Measurement Location	Matrix	Measurement	Frequency	Experimental QC1	Total No. Samples

1QC samples generated during experiment, as applicable (e.g., blanks, replicate samples, spikes)

3.2 Complete the following table to summarize the sampling and analytical procedures to be used.

Matrix	Measurement	Sampling/ Measurement Method1	Analysis Method1	Sample Container/ Quantity of Sample	Preservation/ Storage	Holding Time(s)2

1Provide details in text, as necessary, if standard method or SOP cannot be referenced

2Both to extraction and analysis, if applicable

SECTION 4.0, QA/QC CHECKS

Complete the following table to summarize QA/QC checks.

Matrix	Measurement	QA/QC Check1	Frequency	Acceptance Criteria	Corrective Action

1Include all QA/QC checks (experimental and analytical, as applicable) for accuracy, precision, detection limits, mass balance, etc. (e.g., matrix spikes, lab control samples, blanks, replicates, surrogates)

SECTION 5.0, DATA REPORTING

Describe data reduction procedures specific to the project.

SECTION 6.0, REFERENCES

Provide references to methods and germane prior publications.

IN ADDITION, WHEN APPLICABLE...

- list all project-specific target analytes (i.e., when a class of compounds is specified in the table)
- indicate if reporting is on a wet or dry weight basis (solid matrices only)
- describe the method used to establish steady-state conditions
- describe how sampling equipment is calibrated
- describe how cross-contamination between samples is avoided
- describe the procedures used to collect representative samples
- describe sample packing and shipping procedures
- describe instrument calibration procedures and acceptance criteria if not included in a referenced method or SOP.
-

Attachment # 2

NHSRC QA To the Statement of Work Requirements/Definitions List

EPA's Quality System Website: <http://www.epa.gov/quality>

EPA's Requirements and Guidance Documents: http://www.epa.gov/quality/qa_docs.html

EPA's Quality System Website: http://www.epa.gov/quality/qa_docs/r5-final.pdf

In accordance with EPA Order 5360.1 A2, conformance to ANSI/ASQC E4 must be demonstrated by submitting the quality documentation described herein. All Quality documentation shall be submitted to the Government for review. The Government will review and return the quality documentation, with comments, and indicate approval or disapproval. If the quality documentation is not approved, it must be revised to address all comments and shall be resubmitted to the Government for approval. Work involving environmental data collection, generation, use, or reporting shall not commence until the Government has approved the quality documentation. The Quality Assurance Project Plan (QAPP) shall be submitted to the Government at least thirty (30) days prior to the beginning of any environmental data gathering or generation activity in order to allow sufficient time for review and revisions to be completed. After the Government has approved the quality documentation, the Contractor shall also implement it as written and approved by the Government.

NHSRC's Quality System Specifications for Extramural Actions -

These requirements typically pertain to single project efforts. The five specifications are:

- (1) a description of the organization's Quality System (QS) and information regarding how this QS is documented, communicated and implemented;
- (2) an organizational chart showing the position of the QA function;
- (3) delineation of the authority and responsibilities of the QA function;
- (4) the background and experience of the QA personnel who will be assigned to the project; and
- (5) the organization's general approach for accomplishing the QA specifications in the SOW.

NHSRC QA Requirements/Definitions List

Category Level Designations (determines the level of QA required):

- ☐ **Category I Project** - applicable to studies performed to generate data used for enforcement activities, litigation, or research project involving human subjects. The QAPP shall address all elements listed in "EPA Requirements for QA Project Plans, EPA QA/R-5.
- ☐ **Category II Project** - applicable to studies performed to generate data used in support of the development of environmental regulations or standards. The QAPP shall address all elements listed in "EPA Requirements for QA Project Plans, EPA QA/R-5.
- ☐ **Category III Project** - applicable to projects involving applied research or technology evaluations. The QAPP shall address the applicable sections of "EPA Requirements for QA Project Plans, EPA QA/R-5 as outlined in the NHSRC's QMP: QAPP requirements for the specific project type (see below).
- ☒ **Category IV Project** - applicable to projects involving basic research or preliminary data gathering activities. The QAPP shall address the applicable sections of "EPA Requirements for QA Project Plans, EPA QA/R-5 as outlined in the NHSRC's QMP: QAPP requirements for the specific project type (see below).

Project Types:

These outlines of NHSRC's QAPP Requirements for various project types, from Appendix B of the NHSRC QMP (except where otherwise noted), are condensed from typically applicable sections of R-5 (EPA Requirements for QA Project Plans) and are intended to serve as a starting point when preparing a QAPP. These lists and their format may not fit every research scenario and QAPP's must conform to applicable sections of R-5 in a way that fully describes the research plan and appropriate QA and QC measures to ensure that the data are of adequate quality and quantity to fit their intended purpose.

- ☐ **Applied Research Project** - pertains to a study performed to generate data to demonstrate the performance of accepted processes or technologies under defined conditions. These studies are often pilot- or field-scale. The QAPP shall address all requirements listed in "QAPP Requirements for Applied Research Projects" from Appendix B of the NHSRC QMP.
- ☒ **Basic Research Project** - pertains to a study performed to generate data used to evaluate unproven theories, processes, or technologies. These studies are often bench-scale. The QAPP shall address all requirements listed in "QAPP Requirements for Basic Research Projects" from Appendix B of the NHSRC QMP.
- ☐ **Design, Construction, and/or Operation of Environmental Technology Project** - pertains to environmental technology designed, constructed and/or operated by and/or for EPA. The QAPP shall address requirements in the EPA Quality System document "Guidance on Quality Assurance for Environmental Technology Design, Construction, and Operation" G-11, at <http://www.epa.gov/quality/QS-docs/g11-final-05.pdf>. For additional information, you may refer to Part C of "Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology," ANSI/ASQC E4-1994, American Society for Quality Control, Milwaukee, WI, January 1995.
- ☐ **Geospatial Data Quality Assurance Project** - pertains to data collection; data processing and analysis; and data validation of geospatial applications. The QAPP shall address requirements in the EPA Quality System document "Guidance for Geospatial Data Quality Assurance Project Plans" G-5S at <http://www.epa.gov/quality/QS-docs/g5g-final-05.pdf>.
- ☐ **Method Development Project** - pertains to situations where there is no existing standard method, or a standard method needs to be significantly modified for a specific application. The QAPP shall address all requirements listed in "QAPP Requirements for Method Development Projects" from Appendix B of the NHSRC QMP.
- ☐ **Model Development Project** - includes all types of mathematical models including static, dynamic, deterministic, stochastic, mechanistic, empirical, etc. The QAPP shall address requirements in the EPA Quality System document "Guidance for Quality Assurance Project Plans for Modeling" G-5M at <http://www.epa.gov/quality/QS-docs/g5m-final.pdf>.
- ☐ **Sampling and Analysis Project** - pertains to the collection and analysis of samples with no objectives other than to provide characterization or monitoring information. The QAPP shall address all requirements listed in "QAPP Requirements for Sampling and Analysis Projects" from Appendix B of the NHSRC QMP.
- ☐ **Secondary Data Project** - pertains to environmental data collected from other sources, by or for EPA, that are used for purposes other than those originally intended. Sources may include: literature, industry surveys, compilations from computerized databases and information systems, and computerized or mathematical models of environmental processes. The QAPP shall address all requirements listed in "QAPP Requirements for Secondary Data Projects" from Appendix B of the NHSRC QMP.
- ☐ **Software Development and Data Management Project** - pertains to software development, software/hardware systems development, database design and maintenance, data validation and verification systems. The QAPP shall address all requirements listed in "QAPP Requirements for Software Development Projects" from Appendix B of the NHSRC QMP.

Definitions:

Environmental Data - These are any measurement or information that describe environmental processes, location, or conditions; ecological or health effects directly from measurements, produced from software and models, and compiled from other sources such as data bases or the literature. For EPA, environmental data include information collected directly from measurements, produced from software and models,

and compiled from other sources such as data bases or literature.

Incremental Funding - Incremental funding is partial funding, no new work.

Quality Assurance (QA) - Quality assurance is a system of management activities to ensure that a process, item, or service is of the type and quality needed by the customer. It deals with setting policy and running an administrative system of management controls that cover planning, implementation, and review of data collection activities and the use of data in decision making. Quality assurance is just one part of a quality system.

Quality Assurance Project Plan (QAPP) - A QAPP is a document that describes the necessary quality assurance, quality control, and other technical activities that must be implemented to ensure that the results of the work performed will satisfy the stated performance criteria. A QAPP documents project-specific information.

Quality Control (QC) - Quality control is a technical function that includes all the scientific precautions, such as calibrations and duplications, which are needed to acquire data of known and adequate quality.

Quality Management Plan (QMP) - A QMP is a document that describes an organization's/program's quality system in terms of the organizational structure, policy and procedures, functional responsibilities of management and staff, lines of authority, and required interfaces for those planning, implementing, documenting, and assessing all activities conducted. A QMP documents the overall organization/program, and is primarily applicable to multi-year, multi-project efforts. An organization's/program's QMP shall address all elements listed in the "Requirements for Quality Management Plans" in Appendix B of the NHSRC QMP.

Quality System - A quality system is the means by which an organization manages its quality aspects in a systematic, organized manner and provides a framework for planning, implementing, and assessing work performed by an organization and for carrying out required quality assurance and quality control activities.

R-2. EPA Requirements for Quality Management Plans (EPA/240/B-01/002) March, 2001 <http://www.epa.gov/quality/QS-docs/r2-final.pdf>.

R-5. EPA Requirements for Quality Management Plans (EPA/240/B-01/002) March, 2001 <http://www.epa.gov/quality/QS-docs/r5-final.pdf>.

Substantive Change - Substantive change is any change in an activity that may alter the quality of data being used, generated, or gathered.

Technical Lead Person (TLP) - This person is technically responsible for the project. For extramural contract work, the TLP is typically the contracting officer's representative (COR). For intramural work, the TLP is typically the Principal Investigator.

Abbreviations:

COR	Contracting Officer's Representative	IAG	Interagency Agreement
NHSRC	National Homeland Security Research Center	QA	Quality Assurance
NRMRL	National Risk Management Research Laboratory	QAM	Quality Assurance Manager
QA ID	Quality Assurance Identification	QMP	Quality Management Plan
QAPP	Quality Assurance Project Plan	SOW	Statement of Work
QS	Quality System	CRADA	Cooperative Research & Development Agreement
TLP	Technical Lead Person		

Attachment #2 to the Statement of Work
Revision 1. March 2008
NHSRC 06/02